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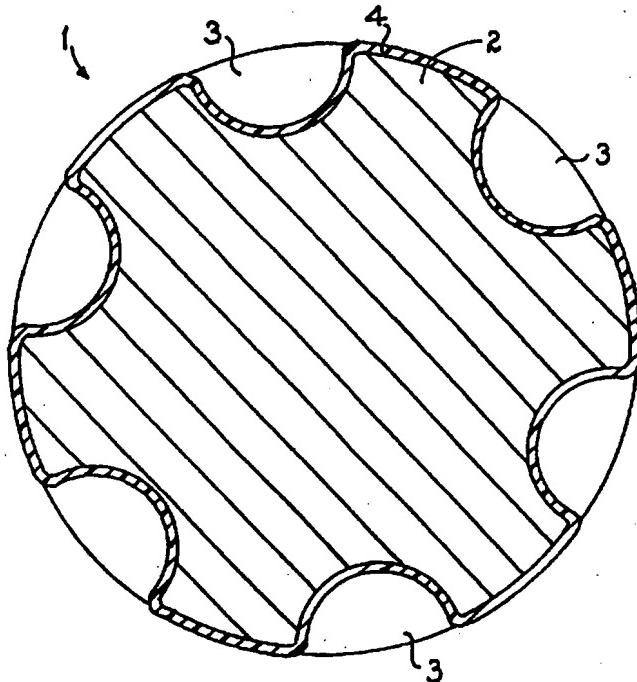


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(54) Title: IMPROVEMENTS IN OR RELATING TO SHOT



(57) Abstract

Shot comprising metallic, e.g. lead, pellets (1) in which each pellet (1) has a surface provided with recesses (3) or projections defining a surface pattern. Each metallic pellet may be provided with one or more layers (4) of one or more coating materials. The invention also relates to a method of producing metallic shot and to a shotgun cartridge incorporating metallic shot.

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Improvements in or Relating to Shot

Technical Field

This invention relates to shot and in particular, but not exclusively, to lead shot, and to a method of 5 manufacturing such shot. Primarily the invention relates to shot for incorporation in shotgun cartridges, but the invention is also intended to cover other types of lead or other metal balls or shot, e.g. shot used as ballast or shot used in concrete, or even other projectiles, e.g. bullets.

10 Background Art

In GB-B-2141360 there is described lead shot for use in shotgun cartridges in which a wear-resistant, non-toxic solid film lubricant is applied to the individual lead pellets to reduce the harm to the environment caused by the 15 spent shot. This known specification states that the solid film lubricant may be applied to the lead pellets by a dip or barrel spray process, normally with the aid of an appropriate adhesive resin. In GB-A-2079418 lead shot for use in shotgun cartridges is described in which lead pellets 20 are coated with molybdenum disulphide to provide a low friction surface on the shot pellets. The application of a coating of molybdenum disulphide to the shot of a shotgun cartridge improves patterns of shot distribution on firing of the cartridge since it prevents the tightly packed shot 25 pellets clinging together when fired and also minimum friction between the shot pellets and the cartridge wall as the pellets are fired from the cartridge.

Disclosure of the Invention

The present invention seeks to provide improved shot, 30 for example pellets or balls of lead or other metal.

According to one aspect of the present invention shot comprising metallic pellets is characterised in that each

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metallic pellet has a surface provided with a plurality of recesses defining a surface pattern.

Preferably the shot is incorporated in a shotgun cartridge and preferably comprises lead pellets or balls.

- 5 In this case the surface recesses conveniently act like "dimples" of a golf ball to improve the flight of the shot after it has been fired from a shotgun.

Preferably each metallic pellet has one or more layers of one or more coating materials which are preferably

- 10 non-toxic and/or wear-resistant. The surface recesses in each pellet increase the surface area of the pellet and facilitates adhesion of the coating material(s). The coating material preferably comprises a low-friction material such as a solid film lubricant, e.g.
- 15 polytetrafluoroethylene or molybdenum disulphide, although other plastics coatings or even metallic coatings, e.g. of nickel, may be employed. Solid film lubricant is the preferred coating material for pellets, especially lead pellets or balls used in shotgun cartridges, since it is
- 20 non-toxic (i.e. it reduces the harm to the environment caused by spent shot), is relatively easy to apply and improves the flight characteristics of the pellets when fired (i.e. the "pattern" of the fired shot is improved) because of its low friction properties which prevent the
- 25 pellets clinging together when fired. In the preferred case of lead pellets, each pellet may be coated with a coherent or continuous coating of the coating material. However even if only a part of the surface area of a lead shot or ball is covered with the non-toxic coating material, the lead pellet
- 30 will not be as damaging to the environment as an uncoated lead pellet.

- It is also desirable to coat the metallic pellets or balls for use in a cartridge with a non-toxic coating having a taste and/or smell or the like specifically intended to
- 35 prevent or discourage animals, e.g. ducks or birds, from attempting to eat or digest the pellets after the pellets

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have been fired from the shot cartridge. Such a coating material is hereinafter referred to as an "abhorrent material" and a typical example of such an abhorrent "taste" material is soap which can be applied in solution as a 5 coating. Other types of abhorent materials may be incorporated in other layers e.g. in a layer of a low-friction material such as polytetrafluoroethylene.

Different coating materials may be applied in different coating operations, such as by a dip or barrel 10 spray process. To assist adhesion of solid film lubricants, adhesive resins may be employed although, as mentioned above, the provision of the surface recesses in the pellets assists in the adhesion of coating materials to the pellets. The coating applied to each pellet may not be thick and by 15 way of example, thicknesses of from 0.01 to 0.02 mm have been found to be satisfactory. If more than one layer is applied to the pellets, the overlying layer or layers may conveniently be porous.

Preferably the surface pattern consists of spaced 20 apart recesses so that each pellet or ball is dimpled in a manner similar to that of a golf ball to improve the ballistic characteristics of the pellet. Such recesses may be of any suitable shape, e.g. part-spherical, frusto-conical, frusto-pyramidal or the like and are preferably 25 symmetrically positioned on the surface of the shot pellets. The recesses may even be in the form of score or cut lines, e.g. in circles around the pellets, but again are preferably uniformly formed and symmetrically arranged on the surface of the shot pellet. In particular the provision of 30 "dimples" or recesses on the surface of the lead or other metal pellets incorporated in a shot cartridge, either leads, on firing the cartridge, to an increase in the velocity of the shot propelled enabling the pellets to travel further and to retain their pattern for a longer 35 distance or leads to the cartridge requiring less propellant to achieve similar results to that of a conventional cartridge. The lethality of such increased velocity shot is

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enhanced and the shot is thus more humane against live quarry such as birds or the like. In addition the number of pellets or balls in the cartridge can be reduced. Although it is preferred for the surface pattern to be regular, this 5 may not be possible to achieve with certain surface deforming techniques, e.g. rolling.

To achieve different effects in shot fired from shotgun cartridges, e.g. different spreads and different distances travelled when fired, the size, depth and shape of 10 the recesses and the thickness of the or each coating (if provided) on the finished pellets can be varied as desired. In the case of dimple-like recesses, these, by way of example, may typically have a depth of from 0.02 to 0.2 mm, e.g. 0.13 mm (0.005 inch) and, as mentioned above, are 15 conveniently part-spherical, part-pyramidal or part-conical in form. The number of such recesses will depend on the diameter of the particular lead or other metal pellet (which may be of any known conventional size), although there will typically be from 10 to 80, e.g. 40, small recesses arranged 20 in a regular or non-regular pattern on an average-sized pellet. More specifically most lead or other metal shot or balls typically have a diameter from 1.0 to 6.0 mm and for a pellet having a diameter of 3.0 mm there may typically be about 50 spaced apart recesses each having a depth of about 25 0.10 mm. However these examples are not intended to be limiting since balls or pellets of different sizes may be used.

According to another aspect of the present invention a method of manufacturing shot comprising metallic pellets 30 is characterised in that a plurality of recesses is formed in the surface of each pellet.

The recesses may be formed in any convenient manner such as by casting or rolling the pellets between rolling members having surface projections. Alternatively, the 35 pellets may be pressed from a sheet of metallic material, e.g. lead or lead alloy material which comprises bringing

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together a pair of dies on opposite sides of the sheet, each die being formed with generally semi-spherical recesses which match with similarly shaped generally semi-spherical recesses in the other die, the surface of each generally 5 semi-spherical die recess being formed with a pattern, preferably a regular pattern, of projections to form recesses in the pressed out pellets.

Suitably at least one coating of material, e.g. a wear-resistant, non-toxic coating, is applied to the 10 pellets. If the pellets are pressed from metallic sheet material, the or a coating may be applied to the sheet prior to said pressing and/or to said pellets after said pressing.

As previously mentioned, the recessed shot pellets are preferably coated with solid film lubricant, examples of 15 such coatings being polytetrafluoroethylene and molybdenum disulphide, or other plastics materials. In addition to reducing the environmental pollution and toxicity of shot, in particular lead shot, the solid film lubricant also improves the ballistic characteristics of pellets fired from 20 shotgun cartridges. The surface recesses in the shot pellets also assist in the adhesion of coating materials to the cores of the shot pellets. The shot pellets may have a taste and/or smell repellent abhorrent material incorporated in any surface coating. Alternatively or additionally such 25 abhorrent material may comprise a separate layer.

Brief Description of Drawing

An embodiment of the invention will now be described, by way of example only, with particular reference to the accompanying drawing, the sole figure of which is a 30 schematic cross-sectional view of a shot pellet or ball for shot according to the invention.

Best Modes of Carrying Out the Invention

The figure shows a substantially spherical lead shot

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ball or pellet 1 having a lead core 2 with a plurality of substantially spaced apart small surface hollows or depressions 3 over its surface. At least one external layer 4 of coating material is applied over the recessed lead core

5 2.

In the production of lead shot comprising a plurality of lead pellets 1, spherical lead cores are initially produced in a conventional manner. The spherical lead pellets are then rolled between rolling members having small 10 projections on their surfaces to form recessed lead cores 2 having recesses or dimples in their surfaces. It is difficult using this rolling procedure to obtain a completely regular arrangement of recesses in the lead cores 2. The dimpled lead cores 2 are then coated with one or 15 more layers of one or more non-toxic materials selected as an abhorrent material, e.g. soap solution, and/or as a low-friction material, e.g. a solid film lubricant such as polytetrafluoroethylene or molybdenum disulphide or other plastics material. Conventional coating methods for coating 20 the lead cores 2 may be employed. Typically, for example, the lead cores 2 may tumbled in the coating material, e.g. an aqueous slurry of finely divided polytetrafluoroethylene, and then dried or sprayed with the coating material and dried.

25 Lead shot pellets 1 so produced are intended to be incorporated in an otherwise conventional shotgun cartridge (not shown) which may, or may not, have a low-friction or lubricating coating, e.g. of polytetrafluoroethylene, applied to the inside of the cartridge shot chamber to 30 minimise the friction of the lead balls or pellets against the cartridge shot chamber wall as the lead pellets are fired from the cartridge in use. The low friction coating applied to the pellets also deters the pellets from clinging together when fixed from a shotgun cartridge.

35 If an abhorrent material coating and a friction-

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minimising coating are applied to a lead core in separate inner and outer layers, respectively, the outer layer may or may not be made porous.

As an alternative to producing the lead cores in a conventional manner, it is possible to press the pellets from a sheet of lead or lead alloy material. The pellets are pressed between two dies having cooperating semi-spherical recesses to form generally spherical lead shot. The inner surfaces of the semi-spherical recesses are provided with projections to produce recesses in the pressed out shot. Since the projections on the semi-spherical recesses can be arranged symmetrically, it is possible to achieve with this method a generally regular surface pattern arrangement of recesses on the lead shot. If it is desired to produce coated shot, the coating operations or operations may be performed on the lead sheet prior to pressing, on the pressed out lead shot or before and after pressing if more than one coating operation is envisaged.

By way of example, the lead pellets of lead shot according to the invention will typically have a diameter of from 1.5 mm to 6.0 mm, e.g. 3 mm, and surface recesses or projections having a depth or height of from 0.02 mm to 0.2 mm, e.g. 0.10 mm. Surface coating layers will typically have a thickness of from 0.01 mm to 0.02 mm.

The provision of recesses, e.g. dimples, grooves or the like, in shot pellets has two main advantages. Firstly, for shot pellets used in shotgun cartridges, the dimples improve the ballistic flight of the shot pellets after firing of a cartridge from a shotgun. Secondly, if a shot pellet is coated with material, the recesses facilitate adhesion of the coating material(s) to the metallic pellets. Coatings may improve the ballistic performance of shot pellets fired from shotgun cartridges, especially if the outer coating is designed as a low friction coating minimising friction between pellets of a cartridge, between pellets and a cartridge wall and between pellets and a

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shotgun barrel. Furthermore, especially in the case of lead pellets, the coating(s) may act as an environmentally friendly barrier to prevent the toxic lead material from coming into contact with the environment in spent shot, to 5 prevent wounded quarry being poisoned by the pellets, and/or to deter animals from digesting spent shot. Any suitable coating which achieves one or more of these objectives may therefore be applied to the recessed shot pellets.

Although the invention primarily relates to lead (or 10 lead alloy) shot for use in shotgun cartridges, it is also intended to cover other metallic shot used in shotgun cartridges, e.g. iron or steel shot, in which the individual metallic shot pellets have a recessed surface. The invention may even be applied to bullets having a dimpled 15 peripheral surface and possibly also having one or more coatings applied thereto. In addition, the invention is intended to cover applications of shot not necessarily intended for use in shotgun cartridges, e.g. shot used as ballast or as a filler in concrete. The pellets of such 20 shot are recessed to facilitate adhesion of at least one protective coating to the pellets or of a composition in which the pellets are embedded (in the case of the shot being used as a filler).

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CLAIMS

1. Shot comprising metallic pellets (1) characterised in that each metallic pellet (1) has a surface provided with a plurality of recesses (3) defining a surface pattern.

2. Shot according to claim 1, characterised in that each metallic pellet is made of lead or a lead alloy.

3. Shot according to claim 1 or 2, characterised in that each pellet (1) comprises a metallic core (2) and at least one layer (4) of one or more preferably non-toxic and/or preferably wear-resistant coating materials.

4. Shot according to claim 3, characterised in that the at least one coating layer (4) comprises a solid film lubricant, e.g. polytetrafluoroethylene or molybdenum disulphide, or other low-friction material.

5. Shot according to claim 3 or 4, characterised in that the at least one coating layer (4) comprises an abhorrent material, e.g. soap, intended to prevent or discourage animals, e.g. ducks or birds, from attempting to eat or digest the metallic pellet.

6. Shot according to claim 1, characterised in that said surface pattern consists of spaced apart recesses (3) uniformly formed on the surface of the metallic pellet.

7. Shot according to claim 1, characterised in that said surface pattern consists of spaced apart recesses (3) each having a depth of from 0.02 to 0.2 mm.

8. Shot according to claim 1, characterised in that said surface pattern consists of spaced apart recesses (3) each having a substantially part-spherical, part-pyramidal or part-conical shape.

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9. A shotgun cartridge incorporating shot according to claim 1, 2 or 3.

10. A method of manufacturing shot comprising metallic pellets (1), characterised by forming a surface pattern of recesses (3) in the surface of each pellet.
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11. A method according to claim 10, characterised in that the surface pattern is formed by rolling the metallic pellets (1) between rolling members having surface projections.

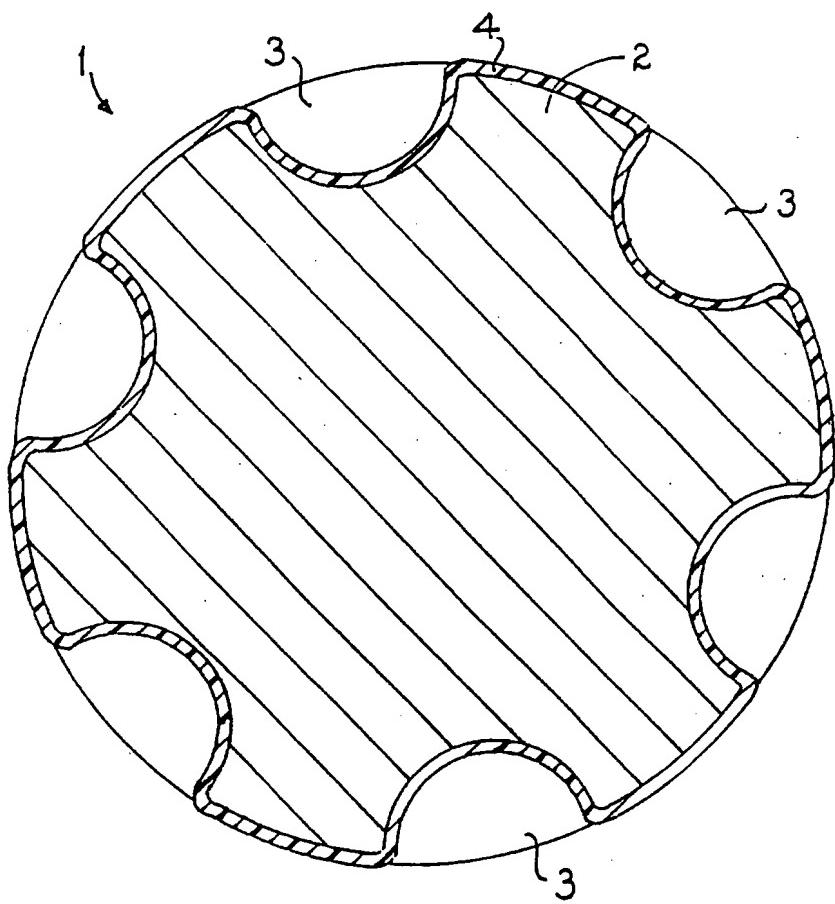
10 12. A method according to claim 10, characterised in that the metallic pellets (1) are pressed from a sheet of metallic material, e.g. lead or lead alloy material, by bringing together a pair of dies on opposite sides of the sheet, each die being formed with generally semi-spherical recesses which match with similarly shaped generally semi-spherical recesses in the other die, the surface of each generally semi-spherical die recess being formed with a pattern, preferably a regular pattern, of projections to form recesses in the pressed out pellets.
15

20 13. A method according to claim 10, characterised in that the at least one layer of coating material, e.g. a wear-resistant, non-toxic coating, is applied to the metallic pellets (1).

25 14. A method according to claim 10, characterised in that the metallic pellets (1) are formed by casting.

15. A projectile, e.g. a bullet or the like, having an outer surface provided with a plurality of recesses and optionally provided with at least one coating layer.

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INTERNATIONAL SEARCH REPORT

International Application No

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A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F42B7/04 A01K95/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 F42B A01K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	---	3-5
Y	US,A,4 731 189 (GREGG JR GEORGE L) 15 March 1988 see claim 2	3-5
X	---	1,2,6-11
Y	GB,A,875 624 (MORRITT) 23 August 1961 see the whole document	3-5
Y	---	3-5
	GB,A,2 141 360 (TAYLOR) 19 December 1984 cited in the application see the whole document	3-5

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Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
9 May 1996	21.05.96
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	US,A,5 200 573 (BLOOD CHARLES L) 6 April 1993 see column 3, line 4 - column 5, line 40; figures 1-8	15
Y	US,A,5 088 415 (HUFFMAN JOHN ET AL) 18 February 1992 see the whole document	15

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Int. Application No

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